Amendments to the Specification

Please replace the paragraph beginning at page 12, line 14 with the following rewritten paragraph:

--Figure ~~2~~ 2a is an SEM image depicting the formation of a 1-D chain of silica micro-spheres grown in the apex region of a V-shaped groove that had been anisotropically etched within the surface of a single crystal (100) silicon wafer.--

Please replace the four (4) consecutive paragraphs beginning at page 12, line 28, ending at page 13, line 12 with the following four (4) rewritten paragraphs:

--Figure [[4]] 4a illustrates the steps ~~steps~~ (v) and (vi) {note that steps (i-iv) are identical to those in Figure 1} of an exemplary, non-limiting synthetic strategy illustrating vectorial control of thickness, area, lattice structure, orientation and registry of silica colloidal crystals in a surface relief pattern on a substrate.

Figure [[4a]] 4b shows a scanning electron microscope (SEM) image illustrating a lateral view of soft lithographically generated square pyramidal and rectangular pyramidal shaped pits inside a Si (100) wafer.

Figure [[4b]] 4c shows SEM images illustrating a top view of a four-layer stack of a well-ordered single crystal silica colloidal crystal grown by spin-coating generated centrifugal forces, gravity driven sedimentation, oscillatory shear and evaporation induced self-assembly of an aqueous dispersion of silica micro-spheres inside a square pyramidal shaped pit within a Si (100) wafer. The figure shows vectorial growth of the silica colloidal crystal to selectively expose the (100) surface.

Figure [[4c]] 4d shows SEM images illustrating a top view of a three-layer stack of a well-ordered single crystal silica colloidal crystal grown by spin-coating generated centrifugal forces, gravity driven sedimentation, oscillatory shear and evaporation induced self-assembly of an aqueous dispersion of silica micro-spheres inside a rectangular pyramidal shaped pit within a Si (100) wafer. The

figure shows vectorial growth of the silica colloidal crystal to selectively expose the (100) surface.—

Please replace the paragraph beginning at page 15, line 13 with the following rewritten paragraph:

-- Figure ~~12~~ 12a shows a computer generated ~~models~~ model of a rectangular-shaped face centered cubic crystal of micro-spheres[[. A]], showing a front view of a ~~(A)~~ {110} surface (direction of the crystal perpendicular to both the bottom and the vertical walls of the channel) ~~and a (B) {112} face (direction of the crystal perpendicular to the vertical walls of the channel) are shown --~~

Please add the following new paragraph immediately prior to the paragraph beginning at page 15, line 18:

--Figure 12b shows a computer generated model of a rectangular-shaped face centered cubic crystal of micro-spheres, showing a front view of a {112} face (direction of the crystal perpendicular to the vertical walls of the channel). --

Please replace the paragraph beginning at page 17, line 20 with the following rewritten paragraph:

-- Figure ~~25~~ 25a illustrates a procedure for the fabrication of a Lincoln Log "Wood-Pile" colloidal crystal superlattice. --

Please add the following two new paragraphs immediately prior to the paragraph beginning at page 17, line 22:

--Figure 25b shows an optical micrograph of a 3-D wood-pile structure

produced using the procedure of Figure 25a after the PDMS is peeled off from the surface of a patterned substrate.

Figure 25c shows an optical micrograph of the 3-D wood-pile structure of Figure 25b after immersion into a dispersion of silica micro-spheres in ethanol with the colloidal micro-spheres self-assembled inside the empty space of the wood-pile structure.--

Please replace the paragraph beginning at page 17, line 26 with the following rewritten paragraph:

--Figure ~~28~~ <u>28a</u> shows ~~(A)~~ <u>an</u> optical micrograph of <u>a modulated thickness colloidal crystal</u> ~~and (B) a corresponding set of optical reflectance spectra~~.--

Please add the following <u>new</u> paragraph immediately prior to the paragraph beginning at page 17, line 28:

--Figure 28b shows a set of reflectance spectra measured employing a micro-spectroscopy technique and corresponding to eight consecutive square colloidal crystal tiles as shown in Figure 28a.--

Please replace the paragraph beginning at page 20, line 9 with the following rewritten paragraph:

--Interestingly, the first micro-spheres to nucleate in the V-shaped grooves are single-file arrangements and these linear constructions are found to be located in the apex of the V-shaped groove. **Figure ~~2~~** <u>2a</u> shows an SEM image depicting the formation of a 1-D chain of silica micro-spheres grown in the apex region of a V-shaped groove that had been anisotropically etched within the surface of a single crystal (100) silicon wafer. These 1-D chains of micro-spheres

dominate in the early stages of infiltration and when dilute aqueous dispersions of micro-spheres are used. At later stages the micro-spheres self-assemble adjacent to the 1-D chains and continue to grow up the walls of the V-shaped grooves to eventually fill them with well-ordered patterns of colloidal crystals. The edges of the grooves seem to be filled first with well-defined lines of microspheres. Further, the observed registry of {100} layer planes of micro-spheres between the grooves provides additional evidence for vectorial control of colloidal crystal nucleation and growth and may be the origin of control of thickness, orientation and registry of the patterned colloidal crystal in the silicon wafer. –

Please replace the paragraph beginning at page 22, line 18 with the following rewritten paragraph:

–TEM grids (400 square mesh or 600 hexagonal mesh) were obtained from SPI Inc. The grid was cleaned by soaking in acetone overnight and then dried in air. The grid was then soaked in chloroform for 5 seconds and immediately transferred to a flat plexiglass substrate. A drop of PDMS pre-polymer was added to the grid area and a block of solid PDMS (1 cm x 1 cm x 0.5 cm) was pressed on the plexiglass. After curing at 60 °C for 8 hrs, the excess polymer was cut off and the PDMS stamp was carefully peeled off from the plexiglass. The stamp was inked and printed on the metal-coated Si (100), followed by selective metal etching and anisotropic silicon etching according to procedures in Example 1. Representative results are shown in Figure ~~2~~ 2a which shows a micrograph of a 1-D colloidal crystal photonic lattice comprising a line of ordered micro-spheres formed in a V-shaped channel in the top surface of a substrate.–

Please replace the paragraph beginning at page 24, line 11 with the following rewritten paragraph:

–Figure [[4]] 4a shows steps (V) and (VI) {note that steps (i-iv) are identical to those in Figure 1} of an exemplary, non-limiting synthetic strategy

illustrating vectorial control of thickness, area, lattice structure, orientation and registry of silica colloidal crystals in silicon wafers for lab-on-chip and photonic chip technologies. The procedure for making the Si (100) substrate patterned with square pyramidal and rectangular pyramidal pits comprises several steps including

step (i) an ethanolic hexadecanethiol solution (2 mM) is inked on the PDMS master;

step (ii) next the master is placed in conformal contact with a 50 nm Au/5 nm Ti/Si (100) substrate for 5-10 s;

step (iii) the bare gold is etched away by a mixture of 0.001M $K_4Fe(CN)_6$, 0.01M $K_3Fe(CN)_6$, 0.1M $K_2S_2O_3$, 1M KOH for 17 minutes;

step (iv) anisotropic etching of Si (100) by 3M KOH in water/isopropanol mixture at 70°C for 10 minutes;

step (v) involves placing a drop of an aqueous suspension of silica micro-spheres on the surface and in the center of the etched pattern of square pyramidal-shaped and rectangular pyramidal-shaped pits in a Si (100) wafer and spinning the substrate, using a conventional spin-coating instrument, at predetermined speed; and

step (vi) the effect of spinning is to drive by centrifugal forces the aqueous dispersion of silica micro-spheres across the surface of the patterned wafer upon which a combination of gravity driven sedimentation, oscillatory shear forces and evaporation induced self-assembly causes nucleation and vectorial growth of silica colloidal crystals, having controlled thickness, area, lattice structure and orientation, inside the closed pits or indentations in the surface of the substrate.--

Please replace the paragraph beginning at page 25, line 11 with the following rewritten paragraph:

--The process of METHOD 2 follows that of METHOD 1 and commences with a line patterned polydimethylsiloxane (PDMS) master that is obtained by casting a pre-polymer gel from the corresponding lithographically defined photo-resist pattern. A procedure for fabricating grid patterns of, for example square

pyramid-shaped etch pits inside a Si (100) wafer begins with a PDMS master that is inked with an alkanethiol in ethanol. The inked master is then printed twice, mutually at right angles, onto an Au coated Si (100) wafer having a titanium adhesion layer. The bare gold surface is then removed with a cyanide etching solution, and the underlying Si (100) substrate is then anisotropically etched in aqueous base to preferentially expose (100) surfaces and thereby give square pyramidal-shaped etch pits with adjacent walls mutually inclined at 70.6° angles beneath the surface of the wafer, as seen in the scanning electron microscopy (SEM) image in Figure [[4a]] 4b.--

Please replace the paragraph beginning at page 25, line 29 with the following rewritten paragraph:

--The same square pyramidal pattern of etch pits can be obtained in a single alkanethiol inking process but instead using a square grid PDMS master. In a similar procedure the printing can be arranged to give rectangular pyramid-shaped etch pits, as seen in the SEM image in Figure[[4a]] 4b.The method outlined in this method is not intended in any way to be restricted to arrays of square pyramidal-shaped or rectangular pyramid-shaped etch pits inside silicon wafers and can be easily adapted to other etch pit shapes and patterns by using the appropriately designed PDMS master. These patterns include closed finite as well as open continuous etch pits formed on the surface of the planar substrates.--

Please replace the paragraph beginning at page 26, line 35 with the following rewritten paragraph:

--This combination of physicochemical effects cause the micro-spheres to settle and close-pack in an orderly fashion mainly within the etch pits inside the substrate. Micro-spheres not caught in the pits are thrown off the substrate by centrifugal forces. Due to the 70.6° angular geometry of the etched V-shaped grooves and square pyramid-shaped pits, micro-spheres nucleate and grow in a

vectorial fashion exclusively within the grooves and pits to form the desired pattern of fcc colloidal crystals. This can be orchestrated to yield the desired degree of filling and number of micro-sphere layer planes within the etched groves and pits. This can be seen in the SEM images shown in Figures ~~4b, 4c~~ 4c and 4d for the growth of silica micro-spheres within closed finite size etch pits inside oriented (100) silicon substrates. It is noteworthy that {100} layer planes of the silica colloidal crystal are well ordered and organized parallel to the [100] face of the single crystal Si (100) wafer. Over spatial areas sufficiently large for construction of photonic crystal micro-devices, colloidal crystals are seen to be high quality single crystals and can be made essentially free of defects. When micro-sphere vacancies are present in the silica colloidal crystals they can easily be identified, see Figure 6b, 6c, and the effect of different numbers, locations and arrangements of point defects on optical diffraction properties evaluated.--

Amendments to the Drawings

The attached replacement drawing sheets have been revised to correct the identifiers of the Figure numbers as follows:

Replacement sheet which includes Figure 2a replaces the original sheet including Figure 2;

Replacement sheet which includes Figure 4a replaces the original sheet including Figure 4;

Replacement sheet which includes Figure 4b replaces the original sheet including Figure 4a;

Replacement sheet which includes Figure 4c replaces the original sheet including Figure 4b;

Replacement sheet which includes Figure 4d replaces the original sheet including Figure 4c;

Replacement sheet which includes Figure 27 replaces the original sheet including Figure 27a.

Attachment: Replacement Sheets containing Figures 2a, 4a, 4b, 4c, 4d and 27.